## DESCRIPTION

# ALUMINUM EXTRUDED RAW PIPE, METHOD OF MANUFACTURING THE SAME, ALUMINUM PIPE FOR PHOTOSENSITIVE DRUMS, AND METHOD OF MANUFACTURING THE SAME

Priority is claimed to Japanese Patent Application No. 2003-133458 filed on May 12, 2003, and U.S. Provisional Application No.60/478,370 filed on June 16, 2003, the disclosure of which are incorporated by reference in their entireties.

## Cross Reference to Related Applications

This application is an application filed under 35 U.S.C. § 111(a) claiming the benefit pursuant to 35 U.S.C. § 119(e)(1) of the filing date of Provisional Application No.60/478,370 filed on June 16, 2003 pursuant to 35 U.S.C. § 111(b).

## Technical Field

The present invention relates to an aluminum extruded raw pipe preferably used as a photosensitive drum for use in electro photographic devices such as copying machines, printers or facsimile machines, and a method of manufacturing the aluminum extruded raw pipe. It also relates to an aluminum pipe for photosensitive drums and a method of manufacturing the aluminum pipe.

In this specification, the wording of "aluminum" denotes aluminum and its alloy.

## Background Art

Although aluminum extruded members have conventionally been manufactured by extruding a billet manufactured by a float casting method or the like, the obtained extruded members tend to be relatively large in surface roughness due to die lines and the like. Known techniques for obtaining an aluminum extruded member high in surface accuracy by decreasing the surface roughness include: (1) a method of extruding an aluminum alloy to which arsenic of 0.02 to 0.30% is added (see Japanese Unexamined Laid-open Patent Publication No. 52-63110, claim 1); and (2) a method in which an aluminum alloy consisting of Zn: 4 to 7.5 mass%, Mg: 0.20 mass% or more but less than 0.50 mass%; Ti: 0.001 to 0.1 mass%; B: 0.0001 to 0.08 mass%; Fe: less than 0.35 mass%; Si: less than 0.30 mass%; Cu: less than 0.20 mass%; one or more elements selected from the group consisting of Mn: 0.1 to 0.3 mass%, Zr: 0.1 to 0.3 mass% and Cr: 0.05 to 0.2 mass%; and the balance being Al and inevitable impurities is extruded and then subjected to artificial aging treatment (see Japanese Unexamined Laid-open Patent Publication No. 10-298691, claims 1 and 3).

A photosensitive drum for use in electro photographic type printing apparatuses such as copying machines, printers or facsimile machines is used by coating a photosensitive layer thinly on the external circumferential surface thereof. In such a photosensitive drum, it is required to have a smooth surface small in surface roughness in order to improve printing quality by forming an even photosensitive layer on the external circumferential surface. In recent years, under the condition that such various kinds of printing devices have become popular, it has been strongly required to further improve the printing quality by forming a further even photosensitive layer. In order to fulfill such a requirement, it is necessary that such

aluminum pipe for photosensitive drums is controlled to be very small in surface roughness and excellent in surface accuracy. Furthermore, in various applications other than photosensitive drums, the chance of requesting excellent surface accuracy has been increased.

In the aforementioned conventional techniques, however, it is difficult to sufficiently decrease the surface roughness to meet the requirements, and therefore excellent surface accuracy could not be attained.

The present invention was made in view of the aforementioned technical backgrounds, and aims to provide a method of manufacturing an aluminum extruded raw pipe capable of decreasing the surface roughness of the extruded raw pipe and a method of providing an aluminum pipe for photosensitive drums excellent in surface accuracy.

## Disclosure of Invention

In order to attain the aforementioned objects, the inventors have eagerly studied and found the fact that there is a correlation between the maximum value of the thickness of the solidified shell layer of the external circumferential surface of the billet and the surface roughness of the extruded raw pipe obtained by extruding this billet. The inventors have further studied based on this finding and found the fact that when a billet whose maximum value of the solidified shell layer thickness is 13 mm or less is used the surface roughness of the extruded raw pipe can be decreased sufficiently, and then completed this invention. That is, the present invention provides the following means.

(1) A method of manufacturing an aluminum extruded raw pipe, including the step of:

extruding an aluminum billet having a solidified shell layer formed at an external peripheral surface thereof, the solidified shell layer having the maximum thickness of 13 mm or less.

(2) The method of manufacturing an aluminum extruded raw pipe as recited in the aforementioned Item (1), wherein the maximum thickness of the solidified shell layer is 11 mm or less.

(3) The method of manufacturing an aluminum extruded raw pipe as recited in the aforementioned Item (1) or (2), wherein the billet is made of A3003 aluminum alloy.

(4) A method of manufacturing an aluminum billet in accordance with a float casting method, including the step of:

casting an aluminum billet at a casting rate of 95 mm/minute or less.

(5) The method of manufacturing an aluminum billet as recited in the aforementioned Item (4), wherein the casting is performed at a casting rate of 85 to 90 mm/minute.

(6) A method of manufacturing an aluminum billet in accordance with a float casting method, including the step of:

casting an aluminum billet while keeping a distance from a lowermost portion of a mold to an upper surface position of a molten aluminum to be 40 mm or less.

(7) The method of manufacturing the aluminum billet as recited in the aforementioned Item (6), wherein the casting is performed while keeping the distance from the lowermost portion of the mold to the upper surface position of the molten aluminum to be 30 to 35 mm.

(8) A method of manufacturing an aluminum billet in accordance with a float casting method, including the step of:

casting an aluminum billet at a casting rate of 95 mm/minute or less while keeping a distance from a lowermost portion of a mold to an upper surface position of a molten aluminum to be 40 mm or less.

(9) The method of manufacturing an aluminum billet as recited in any one of the aforementioned Items (4) to (8), wherein an A3003 aluminum alloy is used as a molten aluminum.

(10) A billet manufactured by the method as recited in any one of the aforementioned Items (4) to (9).

(11) A method of manufacturing an aluminum extruded raw pipe, including the step of:

extruding the billet manufactured by the method as recited in any one of the aforementioned Items 4 to 9.

(12) A method of manufacturing an aluminum extruded raw pipe as recited in any one of the aforementioned Items (1), (2), (3) and (11), wherein the aluminum extruded raw pipe is an aluminum extruded raw pipe to be used as a photosensitive drum.

(13) An aluminum extruded raw pipe manufactured by the method as recited in any one of the aforementioned Items (1), (2), (3) and (11).

(14) An aluminum extruded raw pipe to be used as a photosensitive drum, wherein the aluminum extruded raw pipe is manufactured by the method as recited in any one of the aforementioned Items (1), (2), (3) and (11).

(15) A method of manufacturing an aluminum pipe to be used as a photosensitive drum, including the step of:

subjecting the aluminum extruded raw pipe manufactured by the method as recited in any one of the aforementioned Items (1), (2), (3) and (11) to a drawing

process.

(16) A method of manufacturing an aluminum pipe to be used as a photosensitive drum,

subjecting the aluminum extruded raw pipe manufactured by the manufacturing method as recited in any one of the aforementioned Items (1), (2), (3) and (11) to an ironing process.

(17) An aluminum pipe to be used as a photosensitive drum, wherein the aluminum pipe is manufactured by the method as recited in the aforementioned Items (15) or (16).

According to the invention as recited in the aforementioned Item (1), since the extruded raw pipe is manufactured by extruding the billet whose maximum thickness of the solidified shell layer formed at the external periphery surface is 13 mm or less, the surface roughness of the obtained extruded raw pipe can be made small. As a result, an extruded raw pipe excellent in surface accuracy can be provided.

According to the invention as recited in the aforementioned Item (2), since the billet whose maximum thickness of the solidified shell layer is 11 mm or less is used, an extruded raw pipe excellent in surface accuracy in which the surface roughness is further suppressed can be provided.

According to the invention as recited in the aforementioned Item (3), an aluminum extruded raw pipe which can be preferably used as a photosensitive drum can be provided.

According to the invention as recited in the aforementioned Item (4), a billet whose maximum thickness of the solidified shell layer of the external peripheral surface is 13 mm or less can be provided.

According to the invention as recited in the aforementioned Item (5), a billet

whose maximum thickness of the solidified shell layer of the external peripheral surface is 13 mm or less can be provided assuredly.

According to the invention as recited in the aforementioned Item (6), a billet whose maximum thickness of the solidified shell layer of the external peripheral surface is 13 mm or less can be provided.

According to the invention as recited in the aforementioned Item (7), a billet whose maximum thickness of the solidified shell layer of the external peripheral surface is 13 mm or less can be provided assuredly.

According to the invention as recited in the aforementioned Item (8), a billet whose maximum thickness of the solidified shell layer of the external peripheral surface is 11 mm or less can be provided assuredly.

According to the invention as recited in the aforementioned Item (9), by extruding the billet made of this aluminum alloy, an aluminum extruded raw pipe which can be preferably used as a photosensitive drum can be obtained.

By extruding the billet according to the invention as recited in the aforementioned Item (10), an aluminum extruded raw pipe which can be preferably used as a photosensitive drum can be obtained.

According to the invention as recited in the aforementioned Item (11), the surface roughness of the obtained extruded raw pipe can be suppressed. Thus, an extruded raw pipe excellent in surface accuracy can be provided.

According to the invention as recited in the aforementioned Item (12), an aluminum extruded raw pipe excellent in surface accuracy to be used as a photosensitive drum can be provided.

The aluminum extruded raw pipe according to the invention as recited in the aforementioned Item (13) is small in surface roughness and excellent in surface

accuracy.

The aluminum extruded raw pipe to be used as a photosensitive drum according to the invention as recited in the aforementioned Item (14) is small in surface roughness and excellent in surface accuracy.

According to the inventions as recited in the aforementioned Items (15) and (16), an aluminum pipe to be used as a photosensitive drum small in surface roughness and excellent in surface accuracy can be provided.

The aluminum pipe to be used as a photosensitive drum according to the invention as recited in the aforementioned Item (17) is excellent in surface accuracy.

## Brief Description of Drawings

Fig. 1 is a cross-sectional view of a billet.

Fig. 2 is an explanatory view showing a float casting method.

## Best Mode for Carrying Out the Invention

In a method of manufacturing an aluminum extruded raw pipe according to the present invention, an aluminum billet 1 whose maximum value of the thickness T of the solidified shell layer 2 of the external peripheral surface is 13 mm or less pipe (see Fig. 1) is extruded into an extruded raw. In this method, since the billet 1 in which the maximum value of the thickness T of the solidified shell layer 2 is 13 mm or less, an extruded raw pipe small in surface roughness and excellent in surface accuracy can be obtained. Accordingly, when this aluminum extruded raw pipe obtained as mentioned above is subjected to a drawing process or an ironing process, an aluminum pipe small in surface roughness and excellent in surface quality can be obtained. Although the obtained aluminum pipe can be preferably used as a photosensitive drum,

the application is not limited to it. In the meantime, the cross-sectional structure of the ingot (billet) includes a chill layer formed at the outermost periphery, a rough cell layer formed at the inner side of the chill layer, and an even and fine cell layer (granular crystal layer) formed at the inner side of the rough cell layer. The aforementioned "solidified shell layer" denotes a combination of the chill layer and the rough cell layer, i.e., the layers located outside the cell layer (granular crystal layer). In Fig. 1, the reference numeral 3 denotes the fine cell (granular crystal) layer.

Although setting the maximum value of the thickness T of the solidified shell layer 2 to 13 mm or less is not greatly effected by the billet diameter, the billet diameter is preferably 125 mm (5 inches) to 200 mm (8 inches), more preferably about 150 mm (6 inches).

With regard to the fact that an extruded raw pie excellent in surface accuracy can be obtained by using the billet whose maximum value of the thickness of the solidified shell layer 2 is 13 mm or less, it is believed that there is a possibility that the features of the texture of the solidified shell layer 2, i.e., crystal grains are rough and there are many segregations and therefore crystallized objects tend to become rough, affect the surface accuracy of the extruded raw pipe. However, the reasons of improving the surface accuracy of the extruded raw pipe have not been made clear.

In the manufacturing method of the present invention, it is preferable to use a billet 1 whose maximum value of the thickness T of the solidified shell layer 2 of the external peripheral surface is 11 mm or less. By using this billet, an extruded raw pipe in which the surface roughness is further suppressed can be manufactured.

The composition of the aluminum billet 1 is not specifically limited. For example, Al-Mn series aluminum alloy, Al-Mn-Si series aluminum alloy, Al-Mg series aluminum alloy, and pure aluminum can be exemplified. Among other things, for

photosensitive drums, A3003 or A6063 aluminum alloy can be preferably used.

An aluminum billet 1 whose maximum value of the thickness T of the solidified shell layer 2 of the external peripheral surface is 13 mm or less can be manufactured, for example, as follows: In manufacturing an aluminum billet in accordance with a float casting method, the casting of a billet is performed at a casting rate of 95 mm/minute or less. The float casting method will be explained. In this method, as shown in Fig. 2, the molten aluminum 10 reserved in the container 17 is discharged downward via the float 16 and cooled by the spraying water 15 from the mold 13 to thereby form a billet 11(1). At this time, by setting the downward moving rate of the bottom block 12 supporting the billet 11(1), or the casting rate, to 95 mm/minute or less, an aluminum billet 1 whose maximum value of the thickness T of the solidified shell layer 2 of the external periphery is 13 mm or less can be manufactured. In Fig. 2, the reference numeral 14 denotes cooling water reserved in the mold 14.

Among other things, it is preferable to set the casting rate to 85 to 90 mm/minute. Under this condition, a billet 1 whose maximum value of the thickness T of the solidified shell 2 is 13 mm or less can be assuredly manufactured while maintaining excellent productivity.

Thus, when the billet manufactured by the float casting method by setting the casting rate to 95 mm/minute or less is subjected to an extrusion process, an extruded raw pipe excellent in surface accuracy in which the surface roughness is suppressed can be obtained.

An aluminum billet 1 whose maximum value of the thickness T of the solidified shell layer 2 of the external periphery is 13 mm or less can also be manufactured by the following method. That is, in manufacturing an aluminum billet in accordance with the float casting method, the distance H from the lowermost portion of the mold

14 to the upper surface position of the molten aluminum (the height of the molten aluminum surface) is set to 40 mm or less to cast the billet (see Fig. 2). The casting under the condition enables the manufacturing of an aluminum billet 1 whose maximum value of the thickness T of the solidified shell layer 2 of the external peripheral surface is 13 mm or less. Among other things, it is preferable to set the height H of the molten aluminum surface to 30 to 35 mm.

Thus, when the billet 1 manufactured by the float casting method by setting the height H of the molten aluminum surface to 40 mm/minute or less is subjected to an extrusion process, an extruded raw pipe excellent in surface accuracy in which the surface roughness is suppressed can be obtained.

In manufacturing an aluminum billet in accordance with a float casting method, one of the preferable methods is to cast a billet by setting the casting rate to 95 mm/minute or less and the height H of the molten aluminum surface to 40 mm or less. The most preferable method is to cast a billet by setting the casting rate to 80 to 90 mm/minute or less and the height H of the molten aluminum surface to 30 to 35 mm. In these cases, a billet whose maximum value of the thickness T of the solidified shell layer 2 of the external peripheral surface is 11 mm or less can be assuredly manufactured. Thus, when the obtained billet 1 is subjected to an extrusion process, an extruded raw pipe excellent especially in surface accuracy in which the surface roughness is suppressed can be obtained.

When the aluminum extruded raw pipe obtained as mentioned above is subjected to a drawing process or an ironing process, an aluminum pipe excellent in surface quality and small in surface roughness can be manufactured. The obtained aluminum can be preferably used as a photosensitive drum, but is not specifically limited to it.

Although the aluminum extruded raw pipe obtained by the manufacturing method of this invention is preferably used to manufacture an aluminum pipe to be used as a photosensitive drum, it is not limited to this application. For example, the aluminum extruded raw pipe can be used as materials required to be excellent in surface accuracy in various fields including the fields of architecture, articles for daily use, transportation, education, medical practice and entertainment.

Next, concrete examples of this invention will be explained.

<Example 1>

A billet (diameter 155.5 mm x length 5700 mm) was manufactured by the float casting method using A3003 aluminum alloy as molten aluminum by setting the casting rate to 93 mm/minute and the height H of the molten aluminum surface to 45 mm. The obtained billet was 13 mm in maximum thickness of the solidified shell layer of the external peripheral surface.

Then, the billet was extruded into an aluminum extruded raw pipe (outer diameter 32 mm x thickness 1.5 mm) under the following conditions:

(Extrusion conditions)

Extrusion temperature: 450 ℃

Extrusion rate: 30 mm/minute

The obtained aluminum extruded raw pipe was subjected to a drawing process to obtain an aluminum pipe to be used as a photosensitive drum.

<Example 2>

In the same manner as in Example 1 except that the casting rate was set to 90 mm/minute, an aluminum extruded raw pipe was obtained. The maximum value of

the thickness of the solidified shell layer of the external peripheral surface of the billet was 11 mm. The obtained aluminum extruded raw tube was subjected to an ironing process to obtain an aluminum pipe to be used as a photosensitive drum.

<Example 3>

In the same manner as in Example 1 except that the casting rate was set to 85 mm/minute, an aluminum extruded raw pipe was obtained. The maximum value of the thickness of the solidified shell layer of the external peripheral surface of the billet was 8.3 mm. The obtained aluminum extruded raw tube was subjected to a drawing process to obtain an aluminum pipe to be used as a photosensitive drum.

<Example 4>

A billet (diameter 155.5 mm x length 5,700 mm) was manufactured by the float casting method using A3003 aluminum alloy as molten aluminum by setting the casting rate to 130 mm/minute and the height H of the molten aluminum surface to 35 mm. The obtained billet was 4.8 mm in maximum thickness of the solidified shell layer of the external peripheral surface.

Then, the billet was extruded into an aluminum extruded raw pipe (outer diameter 32 mm x thickness 1.5 mm) under the same conditions as in Example 1. The obtained aluminum extruded raw pipe was subjected to an ironing process to obtain an aluminum pipe to be used as a photosensitive drum.

<Example 5>

In the same manner as in Example 4 except that the height of the molten aluminum surface is set to 30 mm, an aluminum extruded raw pipe was obtained.

The maximum value of the thickness of the solidified shell layer of the external peripheral surface of the billet was 4.4 mm. The obtained aluminum extruded raw tube was subjected to a drawing process to obtain an aluminum pipe to be used as a photosensitive drum.

<Example 6>

In the same manner as in Example 1 except that the casting rate was set to 90 mm/minute and the height H of the molten aluminum surface is set to 35 mm, an aluminum extruded raw pipe was obtained. The maximum value of the thickness of the solidified shell layer of the external peripheral surface of the billet was 4.2 mm. The obtained aluminum extruded raw tube was subjected to an ironing process to obtain an aluminum pipe to be used as a photosensitive drum.

<Example 7>

In the same manner as in Example 1 except that the casting rate was set to 85 mm/minute and the height H of the molten aluminum surface is set to 30 mm, an aluminum extruded raw pipe was obtained. The maximum value of the thickness of the solidified shell layer of the external peripheral surface of the billet was 4.1 mm. The obtained aluminum extruded raw tube was subjected to a drawing process to obtain an aluminum pipe to be used as a photosensitive drum.

<Comparative Example 1>

In the same manner as in Example 1 except that the casting rate was set to 105 mm/minute and the height H of the molten aluminum surface is set to 50 mm, an aluminum extruded raw pipe was obtained. The maximum value of the thickness of

the solidified shell layer of the external peripheral surface of the billet was 17 mm. The obtained aluminum extruded raw tube was subjected to a drawing process to obtain an aluminum pipe to be used as a photosensitive drum.

<Comparative Example 2>

In the same manner as in Example 1 except that the casting rate is set to 110 mm/minute and the height H of the molten aluminum surface is set to 45 mm, an aluminum extruded raw pipe was obtained. The maximum value of the thickness of the solidified shell layer of the external peripheral surface of the billet was 16 mm. The obtained aluminum extruded raw tube was subjected to a drawing process to obtain an aluminum pipe to be used as a photosensitive drum.

The surface roughness of each extruded raw pipe obtained as mentioned above was measured in accordance with JIS B0601-1994 (The maximum height Ry is regarded as the surface roughness). The external peripheral surface of the extruded raw pipe was touched by fingers to select three most rough points. Then, the surface roughness of each of these selected points was measured, and the maximum value was regarded as the surface roughness. The measurements were made at the position 1 m away from the rear extrusion end of the extruded raw pipe.

In the evaluation of the surface accuracy, "X" denotes that the surface roughness exceeds 7 $\mu$m, and "○" (acceptable) denotes that the surface roughness is 7 $\mu$m or less.

The measurement of the maximum value of the thickness of the solidified shell layer of the external surface of the billet was performed as follows. The thickness of the solidified shell layer was measured at eight points by shifting by 45 degrees

(central angle) in the circumferential direction from the position where it is considered to be the thickest portion in the solidified shell layer 2. Among these eight measured values, the maximum value was employed (see Fig. 1) This measurement was made at the longitudinal central portion of each billet. These results are shown in Table 1.

Table 1

| | Casting conditions | | | Maximum thickness of the solidified shell layer of the obtained billet (mm) | Surface Roughness of Extruded Raw Pipe (μm) | Evaluation of Surface Accuracy |
|---|---|---|---|---|---|---|
| | Casting Temp. (℃) | Casting Rate (mm/min.) | Height H of the molten aluminum surface (mm) | | | |
| Example 1 | 705 | 93 | 45 | 13 | 5.6 | ○ |
| Example 2 | 705 | 90 | 45 | 11 | 3.8 | ○ |
| Example 3 | 705 | 85 | 45 | 8.3 | 3.7 | ○ |
| Example 4 | 705 | 130 | 35 | 4.8 | 3.6 | ○ |
| Example 5 | 705 | 130 | 30 | 4.4 | 3.6 | ○ |
| Example 6 | 705 | 90 | 35 | 4.2 | 3.5 | ○ |
| Example 7 | 705 | 85 | 30 | 4.1 | 3.5 | ○ |
| Comparative Example 1 | 705 | 105 | 50 | 17 | 8.2 | × |
| Comparative Example 2 | 705 | 110 | 45 | 16 | 7.2 | × |

As apparent from Table 1, the aluminum extruded raw pipes of Examples 1 to 7 obtained by the manufacturing method of the present invention were suppressed in the surface roughness and excellent in surface accuracy. To the contrary, the aluminum extruded raw pipes of Comparative Examples 1 and 2 were large in surface roughness and inferior in surface accuracy.

The aluminum pipes to be used as a photosensitive drum of Examples 1 to 7

obtained by the manufacturing method of the present invention were excellent in mirror characteristic. To the contrary, the aluminum pipe to be used as a photosensitive drum of Comparative Examples 1 and 2 were insufficient in mirror characteristic.

According to the first aspect of the invention, an extruded raw pipe small in surface roughness and excellent in surface accuracy can be manufactured.

According to the second aspect of the invention, an aluminum extruded raw pipe excellent in surface accuracy can be manufactured.

According to the third aspect of the invention, an aluminum extruded raw pipe which can be preferably used as a photosensitive drum can be manufactured.

According to the fourth aspect of the invention, a billet whose maximum thickness of the solidified shell layer of the external peripheral surface is 13 mm or less can be manufactured. Accordingly, when this billet is subjected to an extrusion process, an aluminum extruded raw pipe excellent in surface accuracy can be obtained.

According to the fifth aspect of the invention, a billet whose maximum thickness of the solidified shell layer of the external peripheral surface is 13 mm or less can be manufactured assuredly. Accordingly, when this billet is subjected to an extrusion process, an aluminum extruded raw pipe excellent in surface accuracy can be obtained.

According to the sixth invention, a billet whose maximum thickness of the solidified shell layer of the external peripheral surface is 13 mm or less can be provided. Accordingly, when this billet is subjected to an extrusion process, an aluminum extruded raw pipe excellent in surface accuracy can be obtained.

According to the seventh aspect of the invention, a billet whose maximum thickness of the solidified shell layer of the external peripheral surface is 13 mm or less can be provided assuredly. Accordingly, when this billet is subjected to an extrusion process, an aluminum extruded raw pipe excellent in surface accuracy can be obtained.

According to the eighth aspect of the invention, a billet whose maximum thickness of the solidified shell layer of the external peripheral surface is 11 mm or less can be manufactured assuredly. Accordingly, when this billet is subjected to an extrusion process, an aluminum extruded raw pipe excellent in surface accuracy can be obtained.

According to the ninth aspect of the invention, by extruding the billet made of this aluminum alloy, an aluminum extruded raw pipe which can be preferably used as a photosensitive drum can be obtained.

By extruding the billet according to the tenth aspect of the invention, an aluminum extruded raw pipe which can be preferably used as a photosensitive drum can be obtained.

According to the eleventh aspect of the invention, an extruded raw pipe small in surface roughness and excellent in surface accuracy can be provided.

According to the twelfth aspect of the invention, an aluminum extruded raw pipe excellent in surface accuracy to be used as a photosensitive drum can be provided.

The aluminum extruded raw pipe according to the thirteenth aspect of the invention is small in surface roughness and excellent in surface accuracy.

The aluminum extruded raw pipe to be used as a photosensitive drum according to the fourteenth aspect of the invention is small in surface roughness and

excellent in surface accuracy.

According to the fifteenth and sixteenth aspects of the inventions, an aluminum pipe to be used as a photosensitive drum small in surface roughness and excellent in surface accuracy can be provided.

The aluminum pipe to be used as a photosensitive drum according to the seventeenth aspect of the invention is excellent in surface accuracy.

The terms and expressions which have been employed herein are used as terms of description and not of limitation, and there is no intent, in the use of such terms and expressions, of excluding any of the equivalents of the features shown and described or portions thereof, but it is recognized that various modifications are possible within the scope of the invention claimed.

## Industrial Applicability

The aluminum extruded raw pipe of the invention can be preferably used as a photosensitive drum for use in electro photographic devices such as copying machines, printers or facsimile machines.